Citation:

Davison KK, Birch LL. Child and parent characteristics as predictors of change in girls' body mass index. *Int J Obes* 2001; 25: 1,834-1,842.

PubMed ID: 11781765

Study Design:

Longitudinal cohort

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To assess parents' dietary intake and physical activity in addition to children's intake and physical activity as predictors of girls' change in BMI between ages five and seven with the goal to develop a comprehensive and context-based model of girls' change in BMI.

Inclusion Criteria:

- Five years of age at start of study
- Living with both biological parents.

Exclusion Criteria:

- Severe food allergies or chronic medical problems affecting food intake
- Dietary restrictions involving animal products.

Description of Study Protocol:

Recruitment

- Subjects were recruited for the study using flyers and newspaper advertisements
- In addition, families with age-eligible girls within a five-county radius received letters invited them to participate
- Also received follow-up phone calls.

Design

Longitudinal cohort

Blinding

N/A

Intervention

N/A

Statistical Analysis

- Analyses conducted using SAS version 6.12
- Data checked for outliers prior to analysis
- *Predictors of girls' change in BMI:* Hierarchical regression - order of entry of predictor variables was established to reflect the developmental process leading to accelerated changes in children's BMI and the development of overweight.
    - Predictor variables were entered in the following order:
        - Background and confound variables (i.e., family income; parent education status; girls' BMI at age five)
        - Parents' weight status (i.e., familial risk of overweight; partents' change in BMI)
        - Parents' physical activity (i.e., frequency and enjoyment of activity)
        - Parents' dietary intake (i.e., total energy and percentage fat intake)
        - Girls' physical activity (i.e., relative activity and tendency toward activity)
        - Girls' dietary intake (i.e., total energy and percentage fat intake)
- *Familial aggregation of risk factors for overweight:*
    - Correlations among all indicators of weight status, physical activity and dietary intake at time one (baseline); corrrelations between girls' and parents' change in BMI.

Data Collection Summary:

Timing of Measurements

- Time 1: In summer before entry into kindergarten, all variables measured except girls' tendency toward activity
- Time 2: In summer during same period before entry into second grade, measurements included girls', mothers' and fathers' BMI, and girls' tendency toward activity.

Dependent Variables

Girls' change in BMI:

- Measured height and weight; difference between age five and seven years
- Overweight defined as BMI of at least 17.2kg per m^2 at age five and at least 18kg per m^2 at age seven years
- Obese defined as at least 19.3kg per m^2 at age five and at least 21kg per m^2 at age seven years.

Independent Variables

- Girls' dietary intake: Total energy intake and percent of energy from fat (when girls were five, mother's provided three, 24-hour recalls of their daughters' food intake); Analyzed using Nutrition Data Systems (NDS 12A; University of Minnesota)
- Girls' physical activity:
    - Relative activity (time one only): Mothers' response to "How active is your daughter relative to other girls her age?"
    - Tendency toward activity (time two only): Girls completed shortened version of the

Children's Physical Activity Scale (CPA) (Cronbach's alpha for this sample=0.58)

- Parents' change in BMI: Measured height and weight
- Parents' dietary intake: Total energy intake and percent of energy from fat; Semi-quantitative food frequency questionnaire (Kristal)
- Parents' (mothers' and fathers') physical activity:
  - Relative activity: "How many days a week do you exercise or participate in sports?" (Low, Medium, High)
  - Enjoyment of activity: "I exercise or play sports for fun." (really describes me; sort of describes me; does not describe me)
- Familial risk of overweight: Value for familial risk of overweight is 1=neither parent overweight, 2=one parent, 3=both parents).

Variables controlled for:

- Girls' and parents' total energy intake was adjusted for body weight
- Family income
- Parent education status
- Girls' BMI at age five years.

Description of Actual Data Sample:

- *Initial N:* 197 girls and their families; N=185 for analysis after outliers removed
- *Final N:* 168 (only those with complete anthropometric data at both time points)
- *Age: Girls*: 5.4±0.4 years; *Parents*: Mothers: 35.4±4.7 years; *Fathers:* 37.4±5.4 years
- *Ethnicity:* Non-Hispanic white
- *SES:*
  - Well-educated (Two-thirds had at least high school)
  - Equal proportions with annual incomes greater than $35,000; between $35,000 and $50,000 and over $50,000
- *Anthropometrics:* See results section
- *Location:* Central Pennsylvania.

Summary of Results:

Weight Status, Physical Activity and Dietary Intake

Family Weight Status Characteristics

	Time 1		Time 2
Girls			
Mean BMI	14.8 (1.4)		16.5 (2.1)
Mean change in BMI		0.7 (1.1)	
Percentage overweight	16%		19%
Percentage obese	3%		4%

Mothers			
Mean BMI	26.3 (5.6)	0.7 (1.9))	27.0 (6.0)
Mean change in BMI			
Percentage overweight	54%		57%
Percentage obese	18%		23%
Fathers			
Mean BMI	28.0 (4.2)	0.31 (1.2)	28.3 (4.2)
Mean change in BMI			
Percentage overweight	76%		79%
Percentage obese	27%		30%
NOTE: At Time 1, girls were 5 years old; At Time 2, girls were 7 years old.			

- Girls' mean BMI at ages five and seven years and girls' change in BMI reflect population-level patterns for white five- and seven-year old girls
- Strong degree of tracking was noted in girls' BMI from ages five to seven years (r=0.87, P<0.001)
- Girls' change in BMI was correlated with BMI at age five (r=0.36, P<0.001) and BMI at age seven years (r=0.76, P<0.001)
- 80% of girls who were overweight at age five were also overweight at age seven years
- Only 9% of girls became overweight between ages five and seven years
- Approximately half of mothers were overweight (BMI at least 25kg per m^2), reflecting population estimates among women; three-quarters of fathers were overweight, slightly higher than population estimates for men
- Girls' and mothers' reports of girls' *activity* indicated that girls were moderately active. Parents' reports of their own activity indicated that mothers exercised one to three days per week, whereas fathers tended not to exercise.
- Both mothers and fathers reported an average likeing for physical activity
- *Mean energy intake* (not controlling for body weight): Girls 1,517 + 311kcal; Mothers 1,807 + 685kcal; Fathers 2,058 + 670kcal
- *Mean percentage energy from fat:* Girls 31%; Mothers and fathers 36%.

Predictors of Girls' Change in BMI from Age Five to Seven Years

The final model was significant (P<0.0001) and explained 26% of the variance in girls' change in BMI (r^2=0.26).

Girls with greater increases in BMI between ages five and seven years had a higher BMI at age five years (P<0.0001 at entry into model); explained 15% of variance. Other variables explained a further 11% of variance:

- Higher family risk of overweight (P=0.005 at entry into model)
- Higher change in mothers' BMI (P=0.05 at entry)
- Fathers who enjoyed activity less (P=0.01 at entry)

- Fathers with higher energy intake, controlling for body weight (P=0.09 at entry)
- A higher percent energy from fat at age five years (P<0.01 at entry).

Girls' energy intake at age five (controlling for body weight) was not significantly associated with girls' change in BMI between age five and seven years (P<0.70).

Analysis of data for those families for which there was complete data for all variables (N=142) did not show meaningful changes in results.

Familial Aggregation of RiskFactors for Overweight

Over 25% of correlations calculated were significant, illustrating the extent to which risk factors for overweight cluster within families (* P<0.05; ** P<0.01).

Significant associations between girls' and parents' weight status:

- Girls BMI and family risk overweight (r=0.19**); Moms' BMI (r=0.14**); Dads' BMI (r=0.21**)
- Moms' BMI and family risk overweight (r=0.65**); Dads' BMI (r=0.22**)
- Dads' BMI and family risk overweight (r=0.21**)

Significant physical activity associations:

- Moms' and dads' frequency of activity were positively correlated (r=0.18*)
- Mom's frequency of activity negatively correlated with moms' BMI (r= -0.15*) and girls' tendency toward activity (r= 0.16*)
- Moms' enjoyment of activity negatively correlated with family risk overweight (r= -0.16*)
- Dads' frequency of activity negatively correlated with dads' BMI (r= -0.18**)
- Dads' enjoyment of activity positively correlated with dads' frequency of activity (r= 0.38**).

Significant dietary intake associations:

- Girls' energy intake not associated with any weight status or physical activity variable.
- Girls' energy intake positively assocciated with moms' energy intake (r=0.19**); Dads' energy intake (r=0.16*)
- Girls' percentage fat intake positively associated with moms' percentage fat intake (r= 0.22**); and negatively associated with moms' frequency of activity (r= -0.20**)
- Moms' energy intake positively associated with moms' enjoyment of activity (r= 0.24**) and moms' percentage fat intake (r=0.22**)
- Moms' percentage fat intake positively associated with moms' BMI (r=0.19**) and negatively associated with moms' enjoyment of activity (r= -0.20**) and moms' frequency of activity (r= - 0.21**); Dads' frequency of activity (r=-0.18**)
- Dads' energy intake positively associated with moms' energy intake (r=0.19**)
- Dads' percentage fat intake positively associated with dads' BMI (r=0.20**); Dads' energy intake (r= 0.41**); and negatively associated with dads' frequency of activity (r= -0.26**) ; Dads' enjoyiment of activity (r= -0.16*).

Partial correlations calculated between girls and parents' change in BMI, controlling for girls' and parents' BMI when girls were five years:

- Mothers' and fathers' change in BMI were positively correlated (r=0.20, PM<0.01) and girls' change in BMI was positively and marginally correlated with mothers' (r=0.14, P<0.10), but not fathers' BMI.

Author Conclusion:

Results from this study highlight the centrality of the family in the etiology of childhood overweight and the necessity of incorporating parents in the treatment of childhood overweight.

Reviewer Comments:

Use of food frequency for parents' dietary intake and use of one question for physical activity assessment are less reliable measures that might obscure some potential associations.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes

3.	**Were study groups comparable?**	N/A
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A

5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes

	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		Yes
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	Yes